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14. ABSTRACT

Prior to current efforts to document combat casualty care and outcome in OEF/OIF, the WDMET was the largest collection of detailed combat casualty injuries available to guide military medical planners. The WDMET database collected in the later half of the Vietnam War remains a valuable research tool. This project has mapped some 7832 patient's injuries from over 3,000 combat incidents that are recorded in the WDMET into contemporary injury severity taxonomies including injury severity scoring. The IECC is a collection of other combat casualty injury data (American, British and Israeli) also mapped from AIS-98 to AIS 2005 Civilian and Military. The result is that the WDMET and IECC databases are now usable in a fashion that can relate to contemporary injury databases, particularly the datasets that are being developed from the contemporary conflicts in Iraq and Afghanistan. This project has executed a fundamental step in furthering the understanding of the nature and severity of combat injury. It provides an analyzable database to combine or contrast with OEF/OIF data.

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WDMET, Combat Casualty Data, Severity Scoring, AIS, ISS

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Table of Contents

Introduction

Although the tactical environment and protection may have changed over the years, contemporary combat data has shown that many weapons systems used in urban and insurgency combat have not. Small arms fire, RPG's, grenades and IED's were common mechanisms of injury in Vietnam and are also the main mechanisms of injury in the current conflicts. What are the patterns and severity of injury in the WDMET and IECC compared with contemporary combat databases? No comparisons could be made nor any other such questions answered until the injury data in the WDMET and IECC databases are coded in a usable format. The casualty injury data from the WDMET data provides a valuable research tool and legacy database which has yet to be adequately leveraged for the benefit of today's and future combatants.

The injury descriptions in the WDMET (Wound Data and Munitions Effectiveness Team) and IECC (International Early Conflict Care) databases have been coded into ICD-9-CM, ICD-10-CM and AIS-98. A new revision of AIS has been finalized, AIS 2005. AIS 2005 also contains Military severity scores for all injuries for the first time. The WDMET and IECC databases, in order to serve as legacy data for comparison analyses, needed to be coded in AIS 2005 and AIS 2005 Military. This has been accomplished by mapping AIS-98 codes to AIS 2005 and AIS 2005 Military codes.

Background. The foundation for this proposal was laid in 2005-2006 as part of the WDMET contract number WX81XWH-04-C-0134 to code the WDMET injury data and in 2003-2004 as part of IECC contract number DAMD17-01-P-0485 to develop the International Early Conflict Care (IECC) database.

These resources enabled the IECC to enter combat data from other established databases, including British, Israeli and U.S. Somalia and Panama conflict data into one standardized database format. Data for 3735 casualties were collected, entered and coded into an Access format database. The data were validated and transferred to the master database at ISR, AMEDD, Fort Sam Houston, TX.

Coding of the injury data from WDMET which includes both survivors and non-survivors with autopsy data was completed during the WDMET contract (above). The current effort provided for the mapping of the AIS-98 coding of the WDMET and IECC data into AIS 2005 Civilian and Military severity codes thus making it possible to perform comparative or aggregate analyses to contemporary combat data being acquired from Iraq and Afghanistan. They could also be compared with similarly coded civilian data.

Body

OIF-OEF Combat Trauma Registries

Data are being collected for casualties of the current conflicts Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). Data fields include descriptions of the tactical environment, the incident and individual combatant injuries and the care provided at the various stages from point of wounding through to field hospital and outcome. DOD provides funding for the Joint Theatre Trauma Registry (JTTR) and the Navy/Marine Combat Trauma Registry (N/M CTR). The JTTR is based at the Institute for Surgical Research (ISR) at Fort Sam Houston, Texas. The CTR is based at the Naval Health Research Center (NHRC) in San Diego, CA. Both databases collect data on all casualties of OIF and OEF. The N/M CTR focuses data collection on the earlier levels of care, while the JTTR focuses on data collection at the Combat Support Hospitals (CSH) and Level IV at Landstuhl, Germany. Level V data collection began in 2006 at the National Naval Medical Center by the N/M CTR and at Walter Reed Army Medical Center by the JTTR. The data fields for the JTTR and N/M CTR were developed jointly and incorporate all the pertinent data fields from U. S. civilian trauma registries as well as specific incident, tactical and weapon data needed specifically for combat scenarios. Injury data for all Killed in Action (KIA) and Died of Wounds (DOW) casualties for OIF and OEF are being provided to the JTTR by the Office of the Medical Examiner at the Armed Forces (OAFME) Institute of Pathology and will be linked with the field data for the casualties. Data for approximately 15,000 casualties have been entered into the JTTR to date. N/M CTR has 30,000 patient encounters and OAFME has data on 3500 decedents.

JTTR and N/M CTR data are being coded into the injury taxonomy ICD-9-CM. Injury severity scoring for JTTR and the N/M CTR began in June 2005 using the recently published version of the Abbreviated Injury Scale (AIS) 2005. JTTR and N/M CTR injury data coded in AIS 2005 is being mapped to AIS-98 to be comparable with other trauma data sets.

<u>Military Injury Severity Scaling.</u>
Howard Champion, Mimi Lawnick and a committee of military physicians have worked with the Injury Scaling Committee of the AAAM to develop Military AIS severity codes in conjunction with the AIS 2005 revision. AIS 2005 was initially projected to be published in 2004, however, the revision was not completed until October 2005. The 2005 Military supplement was completed in June 2005. Injury data from OIF and OEF as well as the IECC and WDMET will be the first combat injury data coded using this new scoring system. All combat injury data are being coded in Military AIS as well as AIS -98 and AIS 2005 civilian versions. This will allow for comparisons of combat data with many other trauma databases.

Key Research Accomplishments
The overall goal of this proposal was to map the AIS-98 severity scoring of the WDMET and IECC combat casualties into AIS 2005 Civilian and Military scores and calculate Injury Severity Scores (ISS) and New Injury Severity (NISS) scores based on AIS 2005 Civilian and Military codes.

Specific aims:

AIS-98 codes do not map one to one to AIS 2005 for all codes. Approximately 20% of the AIS codes present the following issues which need to be addressed in order to accomplish the mapping. Issues regarding the WDMET and IECC databases which needed to be addressed prior to implementing the mapping program included:

1. Cases where bilateral AIS-98 codes are combined into one AIS 2005 code.
2. Cases where one AIS-98 code maps to two or more AIS 2005 codes.
3. Cases where AIS-98 codes also require specific ICD-9-CM code(s) in order to assign the appropriate AIS 2005 code.
4. The issue of the flat files in the WDMET and IECC databases. The databases required restructuring of the data fields from flat files to transaction files. This restructuring allows for easier queries and analyses of the database.
5. Once the database is restructured, there will need to be a copy of the database with AIS-98 and AIS 2005.

Legacy Databases Cases:

Database	Number of Cases
IECC Somalia	126
IECC Panama	235
IECC UK	2654
IECC IDM	720
WDMET	7832
Total	11,567

Specific aims #1-3 have been completed. Mimi Lawnick mapped each of the approximately 1800 AIS-98 codes to AIS 2005 Civilian and Military in an Excel spreadsheet. Ms. Lawnick indicated each AIS-98 code for bilateral injuries which map to only one code in AIS 2005, each AIS-98 code which maps to two or more AIS 2005 codes and each AIS-98 code which requires one or more ICD-9-CM codes to map to a single AIS 2005 code.

The following chart depicts the number of cases in each database, the number of cases where no injuries could be coded in AIS-98 and therefore not mapped (Blank) and the number of codes mapped by each rule built into the file. There is an overlap of cases in the WDMET and WDMET II files. The total number of cases for WDMET is 7832 however, the exact number of codes cannot be determined until the two files are merged at ISR.

Database	Number Of Cases	Number AIS-98 Codes	Number of AIS-98 Codes Mapped to 2005	# Not Mapped	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5	Blank
IECCA IDM	720	758	744	14	723	7	0	14	0	14
IECCB Panama	235	370	367	3	353	2	0	12	0	3
IECCC UK	2654	3588	3499	89	3355	106	0	38	0	89
IECCD Somalia	126	237	234	3	224	1	0	9	0	3
WDMET	7832	8580	8376	204	8115	164	0	96	1	204
WDMET II	7802	10057	9890	167	9624	150	4	112	0	167

TOTAL: 11,567 casualty cases mapped

Mapping Rules:
1. An AIS98 code has one corresponding AIS2005 code
2. An AIS98 code maps to two AIS2005 codes
3. Bilateral, for a single casualty there exist two identical AIS98 codes which map to a single AIS2005 code
4. An AIS98 code plus a specific ICD9 code for this casualty maps to a specific ASI2005 code
5. An AIS98 code plus a specific ICD9 code for this casualty cannot be mapped to an ASI2005 code and requires manual intervention

Specific Aim #4 has been completed. ISR provided Alan LaPenn, who did the technical work on this project, with a version of the WDMET files stripped of patient identifiers with additional tables to add the mapped codes and severity scores. The IECC database, which was already stripped of patient identifiers, was provided as well, along with the additional tables.   A table of AIS 1998 codes and their corresponding AIS 2005 equivalents were supplied in an MS Excel spreadsheet. Five distinct rules were identified for mapping the data and a new column was created in the spreadsheet and populated with the rule number for each mapping entry.

Six MS Access databases with three different formats were supplied with data to be translated. The data in each case resided in a single table, however the data was currently in a format that would not be easy to map or manipulate. The first step was to put the data in third normal form by extracting the Casualty_ID, AIS98

and ICD9 fields into separate tables using the Casualty_ID as the key for each table. Further study revealed that the Body Region, a key element for mapping and ISS and NISS calculation, was embedded in the AIS98 field. The Body Region was therefore stripped from the AIS98 field and placed in a separate field in the new AIS98 table.

Software was then written in Visual Basic .Net (VB.NET) to implement the rules identified in the spreadsheet for mapping since MS Access lacks a procedural scripting language. The spreadsheet was then loaded into the database in a table. The data from the spreadsheet table was then used in conjunction with the rules implemented in software to map the new AIS98 and ICD-9 tables to the AIS2005 standard for both military and civilian codes creating a new table of AIS98, and corresponding AIS2005 codes.

The newly mapped files were then examined to identify mapping errors or cases were AIS98 codes could not be mapped. The tables were then updated to correct any discrepancies. Ms. Lawnick reviewed the mapping in each file and manually coded those cases where mapping could not be automated. Mr. LaPenn then calculated ISS and NISS severity scores on the corrected data in each file. ISS and NISS calculations on both civilian and military AIS data were performed using the corrected mapping tables indicated above and software developed in VB.NET. Since the severity score is needed to make the calculation and is the last digit in the AIS code it was extracted to a separate field in the table before the calculations were processed.

Both ISS and NISS require that they be calculated on a per-casualty basis. The process used to make the calculation was to iterate over the table grouping calculations by Casualty_ID and sorting by either severity score or by severity score and body region.

NISS calculation sums the square of the three highest severity scores regardless of body region. ISS sums the square of the three highest severity scores from three different body regions. Any casualty with a severity score of 6 causes the calculation to be interrupted and the resulting ISS or NISS is assigned the value of 75. The calculated scores were reviewed by Ms. Lawnick to confirm that the calculations were correct.

Specific aim #5 has been completed. The databases, with the additional tables completed, have been returned on CD to ISR where they will be available as Legacy databases of combat injury. Access to the data will be controlled by COL John Holcomb, Commander of ISR, who also oversees access to the JTTR. Requests for access to WDMET/IECC reports or data will be reviewed and approved by COL Holcomb and provided by ISR IT personnel.

Reportable Outcomes

Summary:

The WDMET is the largest collection of detailed combat casualty injuries available to guide military medical planners. This project has coded some 7,898 patients' injuries from over 3,000 combat incidents that are recorded in the WDMET into contemporary injury severity taxonomies including injury severity scoring. The IECC is a collection of 3,735 combat casualties from smaller conflicts involving either U.S. or other forces. The result is that the WDMET and IECC databases are now usable in a fashion that can relate to other contemporary injury databases, particularly the datasets that are being developed from the contemporary conflicts in Iraq and Afghanistan, for contemporary analyses. This project has executed a fundamental step in furthering the understanding of the nature and severity of combat injury and thus, in its mitigation.

Products:

1) WDMET and IECC data mapped into AIS 2005 Civilian and Military making it usable to researchers.
2) Calculation of ISS and NISS scores based on AIS-98.
3) Calculation of ISS and NISS scores based on AIS 2005 Civilian and AIS 2005 Military
4) Integration of these Legacy databases at ISR with process of current trauma data collection including JTTR, N/M CTR and the National Trauma Registry (NTR).
5) Copyright mapping – Most trauma registries are currently coded in AIS-98. Manually recoding these databases in AIS 2005 would be an extensive and time consuming task. Recoding was accomplished with a computerized mapping of all AIS-98 codes to AIS 2005 codes. However, there is not a one-to-one match of codes. A number of AIS 2005 codes require the AIS-98 code and one or more ICD-9-CM codes in order to assign the correct AIS 2005 code. This mapping was not provided by AAAM with the 2005 revision despite discussions by the International Injury Scaling Committee (IISC) regarding the importance of providing such a mapping. This mapping was developed under this proposal.

Conclusions
This proposal has completed the mapping of the WDMET and IECC combat casualty databases for use as reference legacy databases. WDMET and IECC are now available in a usable format for extrapolation of data, comparisons with other datasets, and outcome analyses with injury severity scoring. This is an important step in advancing military medicine. It fulfills a distinct and pressing need for reference combat injury data to compare with contemporary combat survivor and non–survivor injury data**.**

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